

(Please **PRINT**)

UF Student ID#: _____

----- CEN 4072/6070 Software Testing & Verification -----

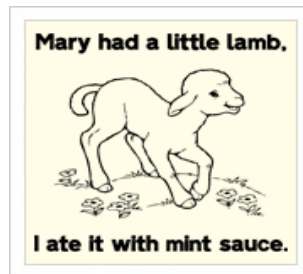
Exam 1 -- Spring 2014

You have 90 minutes to work on this exam. It is a "closed-book/closed-notes" test. Pay attention to point values, since you may not have time to work all 24 problems. PRINT your name and UF ID# above NOW and sign the pledge at the bottom of the last page, if appropriate, when you are finished. PLEASE PRINT ANSWERS IN THE SPACE PROVIDED ONLY – PREFERABLY USING A BALLPOINT PEN TO INCREASE LEGIBILITY. Good luck!

1. (6 pts.) As discussed in class, a distinction is sometimes drawn between the terms *validation testing* and *defect testing*.
 - a. Briefly describe this distinction.
 - b. Explain how the terms are related to the two different definitions of testing attributed to Boris Beizer and Glenford Myers.
2. (9 pts.) Briefly define each of the following software testing-related terms.
 - a. regression testing:
 - b. alpha testing:
 - c. soak testing:

3. (3 pts.) Briefly state the underlying premise upon which Ken Johnston's MVQ testing model for web-based software services builds.

4. (3 pts.) During the discussion of key requirements attributes, the following image was used in connection with describing a particular attribute.



Which one of the following was the attribute being described? (Circle ONE only.)

- | | |
|--------------------|------------------------------|
| a. Completeness | d. Verifiability/Testability |
| b. Consistency | e. Correctness |
| c. Unambiguousness | f. (none of the above) |
5. Suppose the 4-dimensional input space for a function that returns a Boolean value is comprised of 2, 2, 3, and 4 disjoint attribute classes respectively, with no infeasible input combinations.

- a. (6 pts.) What is the minimum number of test cases needed to achieve "Strong Equivalence Class Testing"? What is the minimum number needed to achieve "Weak Equivalence Class Testing"?

minimum # of cases needed for *Strong Equivalence Class Testing*: _____

minimum # of cases needed for *Weak Equivalence Class Testing*: _____

- b. (3 pts.) Suppose a given implementation of this function has a total of 17 execution paths, all of which are feasible. If the function's 4-dimensional input space is partitioned according to the values to which inputs should (based on the function's specification) be mapped, what is the minimum number of test cases needed to ensure coverage of the partitions?

minimum # of cases needed to cover the partitions: _____

6. (14 pts.) For a nominally complete and consistent Cause-Effect model, which, if any, of the following coverage criteria/conditions would necessarily result in *all feasible combinations of Effects* being covered? Indicate "would" or "would not" as appropriate. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the item.

a. AFCCV coverage	would	would not
b. AFCCV coverage when Effects are mutually exclusive	would	would not
c. AE coverage	would	would not
d. AE coverage when Effects are mutually exclusive	would	would not
e. "Strategy #3" coverage	would	would not
f. "Strategy #3" coverage when Effects are mutually exclusive	would	would not
g. "Strategy #3 Plus Culling Rules" coverage	would	would not

7. (12 pts.) Consider pseudocode program:

input (A,B); if (A OR B) then s1 end_if

for Boolean variables A, B and the two test cases:

	A	B
test 1	false	true
test 2	true	false

Which, if any, of the following (true) assertions can be deduced by viewing the program and the given test cases together as a single counter-example? Circle "deducible" or "not deducible" as appropriate for each. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the item.

a. statement coverage \Rightarrow branch coverage	deducible	not deducible
b. branch coverage \Rightarrow condition coverage	deducible	not deducible
c. condition coverage \Rightarrow branch coverage	deducible	not deducible
d. condition coverage \Rightarrow compound condition coverage	deducible	not deducible
e. branch coverage \Rightarrow path coverage	deducible	not deducible
f. statement coverage \Rightarrow p-use coverage	deducible	not deducible

-
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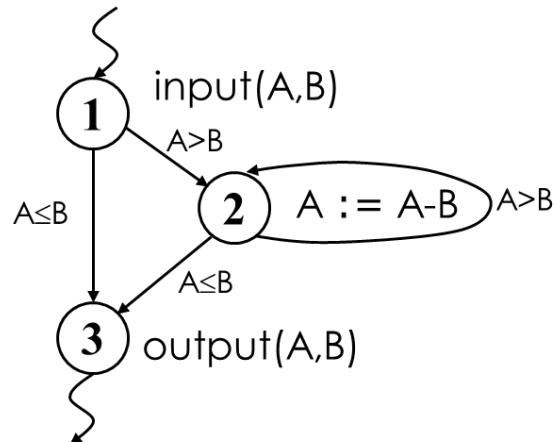
graph LR
 E((E)) -- 6 --> 6((6))
 E -- 7 --> 7((7))
 E -- 8 --> 8((8))
 E -- 9 --> 9((9))
 6 -.-> V((V))
 7 -.-> V
 8 -.-> V
 V --> 24((24))
 9 --> 24

```

d. (3 pts.) Suppose that the instructions for Problem Set 1 had read: "Produce a test case coverage matrix reflecting all combinations of connected Causes resulting in each Effect as represented in the graph(s) subject to the Culling Rules described in class." How many test case templates would be associated with Effect 24 being TRUE in that case?

Number of test case templates if Culling Rules were used: \_\_\_\_\_

9. (20 pts.) Consider the program control flow graph below.

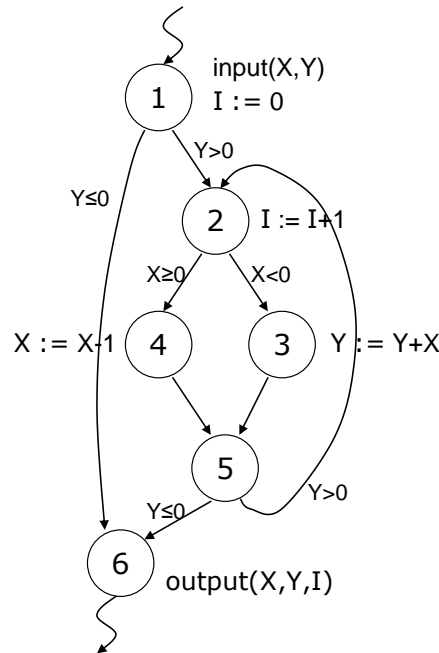


- a. Identify ALL (and ONLY the) du-pairs for variable **A**.  
du-pairs:
  
- b. Identify all (and ONLY the) du-paths associated with each of the following du-pairs for variable **B**:  
 du-paths for (1,2):  
 du-paths for (1,3):  
 du-paths for (1,<2,2>):  
 du-paths for (1,<2,3>):
  
- c. Give the complete, non-simplified path condition for path <1,2,2,2,3> in terms of the *input values* of A and B. (Do not combine or simplify predicates.)
  
- d. Give an example of initial values for A and B, if any, that would satisfy the path condition for the path given in part (c). If none, write "none".

10. (4 pts.) In connection with Problem Set 3, Dataflow Coverage, a diligent student recently wrote:

*Could you please look at the solution for Problem Set 3, Dataflow Coverage, Part C, set 2. The question is, "What coverage is achieved?" The solution says that branch coverage is achieved with set 2. But I don't know how that's possible since the execution path is missing the branch from <1,6>. That branch is not included until Set 3. Am I missing something?*

Here is the control-flow graph given in the Solution Notes in response to: "Provide a control-flow graph suitable for dataflow coverage analysis:"



and here are the Part C execution paths associated with the given test case sets:

**set 1:** <1,2,3,5,6>

**set 2:** set 1 plus <1,2,4,5,2,4,5,2,4,5,2,3,5,6>

**set 3:** set 2 plus <1,6>

What was the "something" that the student was missing in not recognizing that branch coverage would, in fact, be satisfied by test **set 2**?

11. Two forms of "fault-based testing" were discussed in class: Mutation Analysis and Error Seeding.

a. (6 pts.) Briefly state (only) the specific GOAL/OBJECTIVE of each approach:

Goal/Objective of Mutation Analysis:

Goal/Objective of Error Seeding:

b. (6 pts.) Briefly describe ONE potential drawback of each approach that was identified/discussed in class. Be specific.

Potential drawback of Mutation Analysis:

Potential drawback of Error Seeding:

12. Several types of "higher-level tests" were described in class. One of these was "Reliability test."

a. (3 pts.) Two distinct forms of specifying reliability requirements were presented. Precisely state ONE of the two.

b. (3 pts.) Briefly explain WHY an operational profile is required for reliability testing. Be specific.

13. (8 pts.) Match each description below to the **SINGLE MOST APPROPRIATE TERM** related to testing object-oriented software among the following. (Note: terms may apply to none, one, or more than one description.)

- |                             |                                           |
|-----------------------------|-------------------------------------------|
| A. encapsulation            | G. polymorphism                           |
| B. inheritance              | H. observability interfaces               |
| C. unit level O-O testing   | K. state machine models                   |
| D. object classes           | L. methods                                |
| E. use/include relations    | M. UML sequence or collaboration diagrams |
| F. higher level O-O testing | N. inspection operations                  |

- \_\_\_\_\_ Often focuses on object classes as opposed to individual methods, as testing methods in isolation is not always practical
- \_\_\_\_\_ An associated testing issue which arises involves deciding which methods in a derived class need to be (re-)tested
- \_\_\_\_\_ Allows variable types and method bindings to change dynamically, thus requiring testers to be aware of the bindings that may occur
- \_\_\_\_\_ Sometimes required by design rules to circumvent the problem of object state not being directly accessible, but results in some overhead
- \_\_\_\_\_ Allows object classes to be *specialized* or *extended* from one or more other object classes
- \_\_\_\_\_ Facilitates the application of partitioning and combinatorial test case design techniques to account for state-dependent program behavior
- \_\_\_\_\_ Normally begins with the integration of object classes to form inter-object class functional entities
- \_\_\_\_\_ Object-oriented design principle that may necessitate the use of special instrumentation to interpret the effects of methods

14. (4 pts.) In "The six essentials of software testing," Kit's Essential #2 concerns "preventing defect migration."

a. What, exactly, does he mean by "defect migration" in this context?

b. By what general means does Kit propose that defect migration be prevented?



15. a. (3 pts.) In "The Psychology and Economics of Program Testing," Myers quotes the logician Copi to emphasize one of his "vital testing principles":

A problem may be characterized as a fact or group of facts for which we have no acceptable explanation, which seem unusual, or which fail to fit in with our expectations or preconceptions. It should be obvious that *some* prior beliefs are required if anything is to appear problematic. If there are no expectations, there can be no surprises.

State the principle that he was emphasizing.

- b. (3 pts.) Myers begins his explanation of another one of his "vital principles" as follows:

This problem is seen most often in the use of interactive systems to test programs. A common practice is to sit at a terminal, invent test cases on the fly, and then send these test cases through the program...

State the principle that he was explaining.

16. (4 pts.) In "The state of the art and the state of the practice," one of the questions Kit addresses is, "How should testing be positioned?" Which of the following reflects what he means by "positioned" based on how he addresses this question? (Circle ONE only.)

- a. He speaks of positioning in the sense of testing's relative importance and distinctiveness compared to other life cycle activities, and its traditional "subordination" to development as reflected, for example, in the "voice of testing" going unheard, by staffing policies that result in junior or otherwise "spare" people being assigned to testing roles, etc.
- b. He speaks of positioning in the sense of *when* testing activity takes place relative to other life cycle activities: After coding is finished? As a phase near the end of the development cycle? Throughout the entire life cycle of development?
- c. He speaks of positioning in the sense of how testing, as carried out in most organizations today, relates to quality assurance and the quality assurance (QA) function.
- d. (a) and (b) only
- e. (a) and (c) only
- f. (b) and (c) only
- g. (a) and (b) and (c)

17. (12 pts.) In their chapter, *"Making Meetings Work for Everyone,"* Gause and Weinberg offer several observations and recommendations related to making meetings more productive. For each of the following, circle "is" if the observation or recommendation is included in the chapter, and "is not" otherwise. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the item.

- |                                                                                                                                                                                                                                                                                                                |    |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|--------|
| a. A good reason to get agreement on prohibiting personal attacks or put-downs at the <i>calm beginning of a meeting</i> is that nobody will ever object to this at that point in time.                                                                                                                        | is | is not |
| b. Limiting meetings to no more than 3 agenda items keeps them small, short, and relevant to all in attendance.                                                                                                                                                                                                | is | is not |
| c. To help prevent the problem of people coming to meetings they should <b>not</b> attend, be sure that only invited participants are offered refreshments.                                                                                                                                                    | is | is not |
| d. Organizations promote the model of developers working independently (via such devices as individual achievement awards) because in any <i>sizable</i> development project, it is well known that relying on competent individuals working alone is the most reliable way to achieve extraordinary outcomes. | is | is not |
| e. One important device for staying out of emergency mode is the time-out, when meeting participants agree in advance that anyone can call one-minute or five-minute time-outs at any point without explaining why.                                                                                            | is | is not |
| f. If a project seems to hold too many meetings, it may be a symptom of overstaffing.                                                                                                                                                                                                                          | is | is not |

18. (3 pts.) During the discussion of testing tools, reference was made to the wonder and beauty of springtime in Paris...



Which one of the following test tool types was this reference used to clandestinely introduce? (Circle ONE only.)

- |                                                                    |                                          |
|--------------------------------------------------------------------|------------------------------------------|
| a. Boundary value, equivalence class, and special value generators |                                          |
| b. Parameter value generators                                      |                                          |
| c. Test Harness Generators                                         |                                          |
| d. Code Instrumentation tools                                      | f. Keystroke Recorder and Playback Tools |
| e. Database Test Data Generators                                   | g. (none of the above)                   |

19. (3 pts.) Which one of the following should a Master Test Plan definitely NOT do? (Circle ONE only.)
- a. Define test stages (e.g., unit, component, product, system) schedules, and responsibilities.
  - b. Identify required tools, facilities, and test libraries.
  - c. Specify a regression test *policy*.
  - d. Identify training requirements.
  - e. Define an integration test strategy and identify all scaffolding required with responsibilities and schedules for its production *at a level of detail that could not possibly be known during the project planning and requirements stages, when the Master Test Plan is developed*.
20. (3 pts.) In his paper, "Design and Code Inspections to reduce errors in program development," M.E. Fagan notes that in his experience with inspections, "evidently no manager has tried to 'kill the goose that lays the golden eggs.'" Which one of the following best describes the specific issue to which he was referring? (Circle ONE only.)
- a. The strong inclination of managers to change the adage that, "design is not complete until testing is completed."
  - b. Over-pressuring reviewers to seek high-occurrence, high-cost error types (i.e., "golden eggs").
  - c. The problem of including "bad eggs" (bad fixes or corrections) in a product due to the human tendency to consider any fix to be error-free.
  - d. Pursuing questions raised during an inspection only to the point at which an error is recognized (i.e., without "killing the goose").
  - e. Zealously ensuring that all issues, problems, and concerns discovered in an inspection have been resolved by the owner (the "goose").
  - f. (none of the above)

21. (3 pts.) Recall the question posed in class regarding the "Fisherman's Dilemma:" *You have 3 days for fishing and 2 lakes from which to choose. Day 1 at Lake X nets 8 fish. Day 2 at Lake Y nets 32 fish. Which lake do you return to for day 3?* Which one of the following statements best reflects the primary conclusion drawn about *testing* in connection with this issue? (Circle ONE only.)
- a. Tests should be designed and then executed to demonstrate the correspondence between an element and its specification.
  - b. Program errors seem to come in clusters, so the number of errors already found in part of a program is often a good indicator of whether or not there are more errors in that part.
  - c. Testers should execute programs with the *intent* of finding errors for the same reason that "real fishermen" should fish with the *intent* of catching fish.
  - d. Like fishing, testing is an extremely creative and challenging task .
  - e. Both errors and fish tend to stink if not disposed of within 3 days of having been caught.
22. (10 pts.) The following statements relate to Grady and Van Slack, "KeyLessons in Achieving Widespread Inspection Use." Indicate whether each is true or false. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the item.
- a. The paper begins with an anecdote about a 100 to 1 ROI one of the authors realized in connection with having the heating system inspected in the process of buying a new house. true                      false
  - b. A plot of three Sigmoid (S-shaped) curves are used to illustrate the fact that technology adoption and ROI rates vary widely. true                      false
  - c. A major activity undertaken during HP's "Widespread "(Inspection) Belief and Adoption" stage (1989-1993) was a blitz campaign to promote inspections and a new training class across HP. true                      false
  - d. Divisions responded well to the approach of certifying moderators based on the HP standard, particularly when they saw their inspections working. true                      false
  - e. HP created a measure called "Inspection-process-maturity" based on a five-level model that details the practices early adopting divisions used to improve their peer-review process. true                      false

23. (10 pts.) Match each description below to the **SINGLE MOST APPROPRIATE TERM** among the following. (Note: terms may apply to none, one, or more than one description.)

- |                        |                                  |
|------------------------|----------------------------------|
| A. Fault-based test    | L. "Soak" test                   |
| B. Installability test | M. Device and configuration test |
| C. Thread test         | N. Usability test                |
| D. Alpha test          | O. Serviceability test           |
| E. Performance test    | P. Beta test                     |
| F. Stress test         | R. Security test                 |
| G. "Lights out" test   | S. "Smoke" test                  |
| H. Regression test     | T. Exhaustive test               |
| I. Reliability test    | U. Compatibility/conversion test |
| J. Post-test analysis  | W. Causal analysis               |
| K. Benchmarking        | X. Test-driven development       |

- \_\_\_\_\_ Testing which covers every possible combination of a program's input values
- \_\_\_\_\_ General practice of recording and comparing indices of performance, quality, cost, etc., to help identify "best practices"
- \_\_\_\_\_ Integrating program elements associated with a key program function
- \_\_\_\_\_ Also known as "build verification"; initial test after a software build to detect catastrophic failure
- \_\_\_\_\_ Development process characterized by writing (and running) tests for new increments of functionality *before* they are implemented
- \_\_\_\_\_ Automated, stand-alone testing not requiring human involvement
- \_\_\_\_\_ Focus is on typical requirements that systems exhibit "graceful" failures and non-abrupt performance degradation
- \_\_\_\_\_ Process aimed at identifying the origin of errors and approaches to eliminate future occurrences
- \_\_\_\_\_ Specialized testing in which HCI experts conduct experiments and utilize protocol analysis
- \_\_\_\_\_ Issues of focus include login and password procedures and policies, levels of authorization for data or procedural access, etc.

24. (10 pts.) The following statements relate to Sauer, et al., "The Effectiveness of Software Development Technical Reviews (SDTRs): A Behaviorally Motivated Program of Research." Indicate whether each is true or false. To compensate for random guessing, your score in points will be 2 times the number of [correct minus incorrect] answers, or 0 – whichever is greater. Therefore, if you are not more than 50% sure of your answer, consider skipping the item.

- |                                                                                                                                                                                                                                                                    |      |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| a. The authors note that the behavioral theory of group performance, although developed in the laboratory, has been successfully applied to <i>audit reviews</i> , which are similar to the defect detection task.                                                 | true | false |
| b. Rather than ask whether or not SDTRs are effective in finding more defects than no review at all, the authors' concern is to ask <i>how much more</i> effective they are than this most basic requirement.                                                      | true | false |
| c. The behavioral theory predicts that, where there is no plurality by which to decide whether an issue is a true defect, a group's ability to make a correct discrimination is positively influence by the quality of its group processes.                        | true | false |
| d. The authors note that the underlying theory of review performance provides no systematic basis, in advance of exploratory research, to think that such diverse interventions as N-fold and phased inspections would likely yield significant performance gains. | true | false |
| e. Interacting groups tend to generate a significant number of new, creative problem solutions beyond those already generated in the individual phase of a task.                                                                                                   | true | false |

On my honor, I have neither given nor received unauthorized aid on this exam and I pledge not to divulge information regarding its contents to those who have not yet taken it.

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SIGNATURE